FIRST SPHENIX JET-STRUCTURE MEETING

Dennis Perepelitsa and Rosi Reed

The charge

- RHIC ALD Berndt Mueller -> Plan for baseline design scope, cost, and schedule
  - Data taking in FY2022 RHIC
  - Plan to BNL management no later than **May 31, 2016**
  - Should not assume the availability of additional funding
  - **Foreseen funding profile: "$75M" in redirected funds**
    - 3/25/16 - sPHENIX Total Project Cost 81.37M AY$
- What physics can we do with a $75M sPHENIX?
- What physics would we miss out on?
- What do key observables look like under different detector configurations?

pCDR Statements (1 of 2)

- **Jets** The key to the physics is to cover jet energies of 20–70 GeV, for all centralities, for a range of jet sizes, with high statistics and performance insensitive to the details of jet fragmentation.
  - energy resolution < 120%/$\sqrt{E_{\text{jet}}}$ in p+p for R = 0.2–0.4 jets
  - energy resolution < 150%/$\sqrt{E_{\text{jet}}}$ in central Au+Au for R = 0.2 jets
  - energy scale uncertainty < 3% for inclusive jets
  - energy resolution, including effect of underlying event, such that scale of unfolding on raw yields is less than a factor of three
  - jets down to R = 0.2 (segmentation no coarser than $\Delta\eta \times \Delta\varphi$ ~ 0.1 × 0.1)
  - underlying event influence event-by-event (large coverage HCal/EMCal)
  - Energy measurement insensitive to softness of fragmentation (quarks or gluons) — HCal + EMCal
  - jet trigger capability in p+p and p+A without jet bias (HCal and EMCal) • rejection (> 95%) of high p_T charged track backgrounds (HCal)

pCDR Statements (2 of 2)

- **Dijets** The key to the physics is large acceptance in conjunction with the general require- ments for jets as above
  - > 80% containment of opposing jet axis
  - > 70% full containment for $R = 0.2$ dijets
  - R_{AA} and A_J measured with < 10% systematic uncertainty (also key in p+A, onset of effects)
- **Fragmentation functions** The key to the physics is unbiased measurement of jet energy
  - excellent tracking resolution out to > 40 GeV/c ($dp/p < 0.2\% \times p$)
  - independent measurement of p and E ($z = p/E$)

Experimental inputs

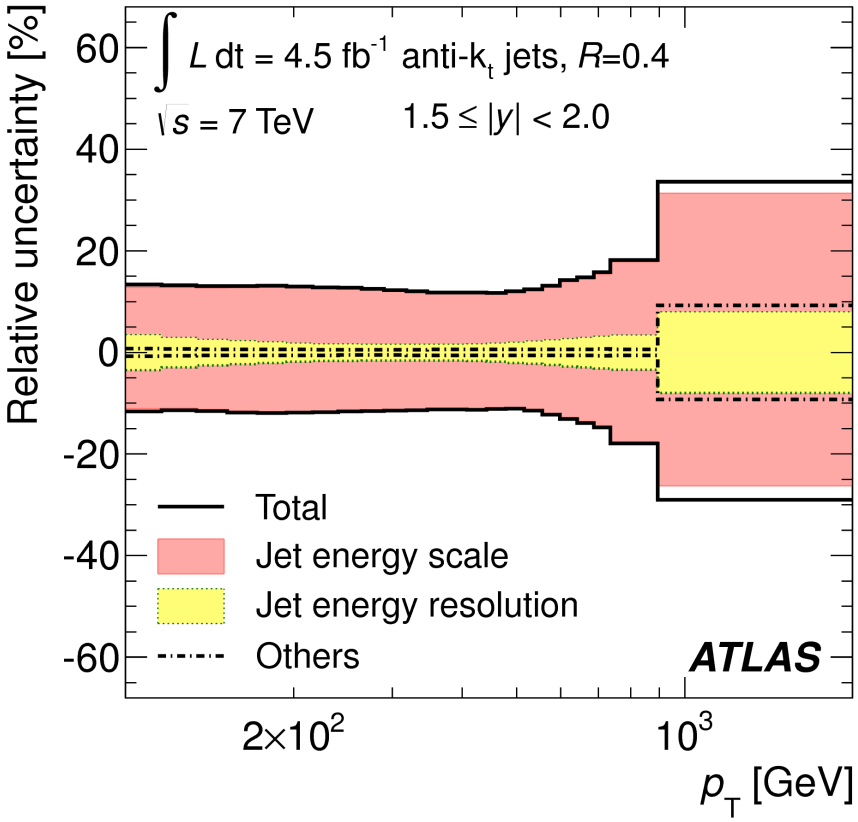
- Topical groups can not “reinvent” sPHENIX
  - We need input regarding efficiency, resolution, fake rate, etc from detector groups
  - Some coordination will be required
    - Common MC?
    - Detector focus from topical group-to-topical group
- We need input regarding detector configurations under different cost assumption
  - We will evaluate performance (efficiency, resolution, fake rate, etc.) for jet structure physics measurements
  - Important to have a few well-vetted results rather than many in various stages of completeness
  - After May 31st we can branch out

Short term plan

- We want to converge on a few crisp, relatively simple observables which demonstrate the effects of the differences between detector configurations
- Proposed signatures
  - Jet energy measurements
  - Charged hadron spectra
  - Fragmentation functions
  - Jet-track Correlations

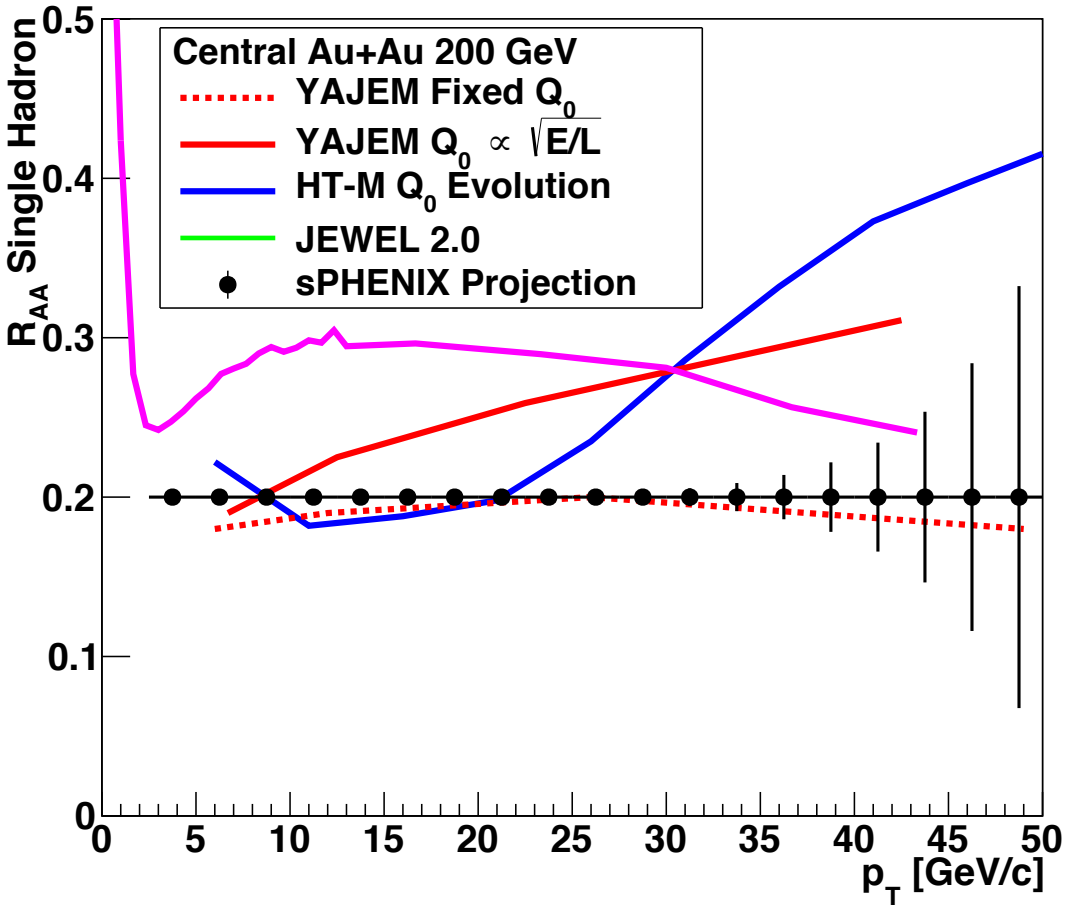
Jet Energy Measurements

- Uncertainty on JES and JER affects all jet measurements
  - We desire small unfolding systematics
  - Need to be able to distinguish real jets from fakes
- For charged-jet energy checks
  - Tracking efficiency
  - Track fake rate effects results
    - Track-Calo matching



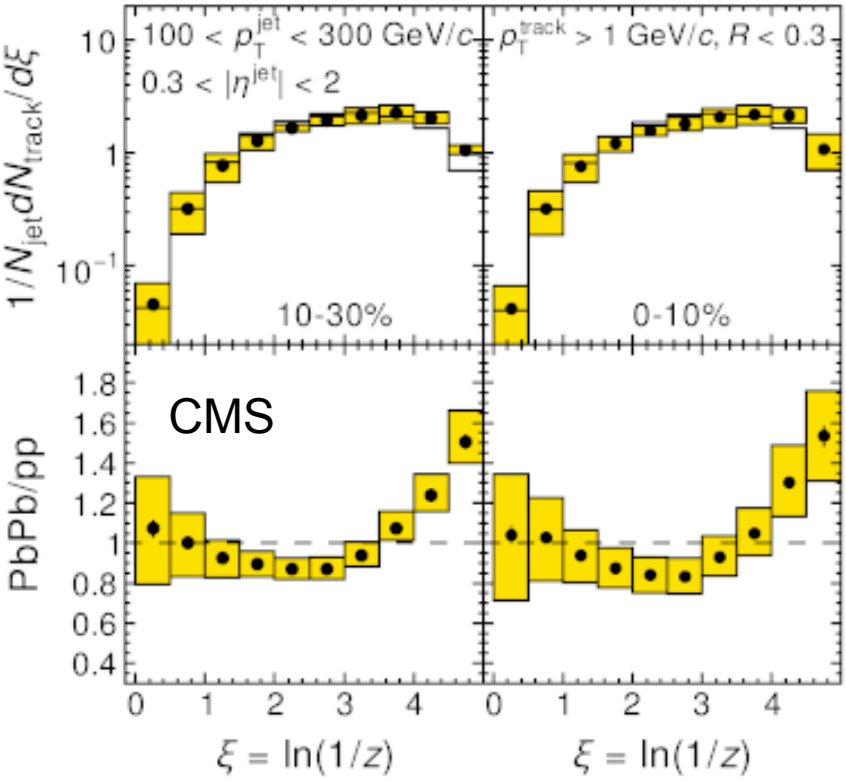
Charged hadron spectra

- At high p_T all charged hadrons should be associated with jets
  - Fake rate at low p_T
  - Uncertainty efficiency
- At low and moderate p_T jet matching is impossible in HI environment
  - Fake rate critical
  - Could be improved by track-to-calo cluster matching?



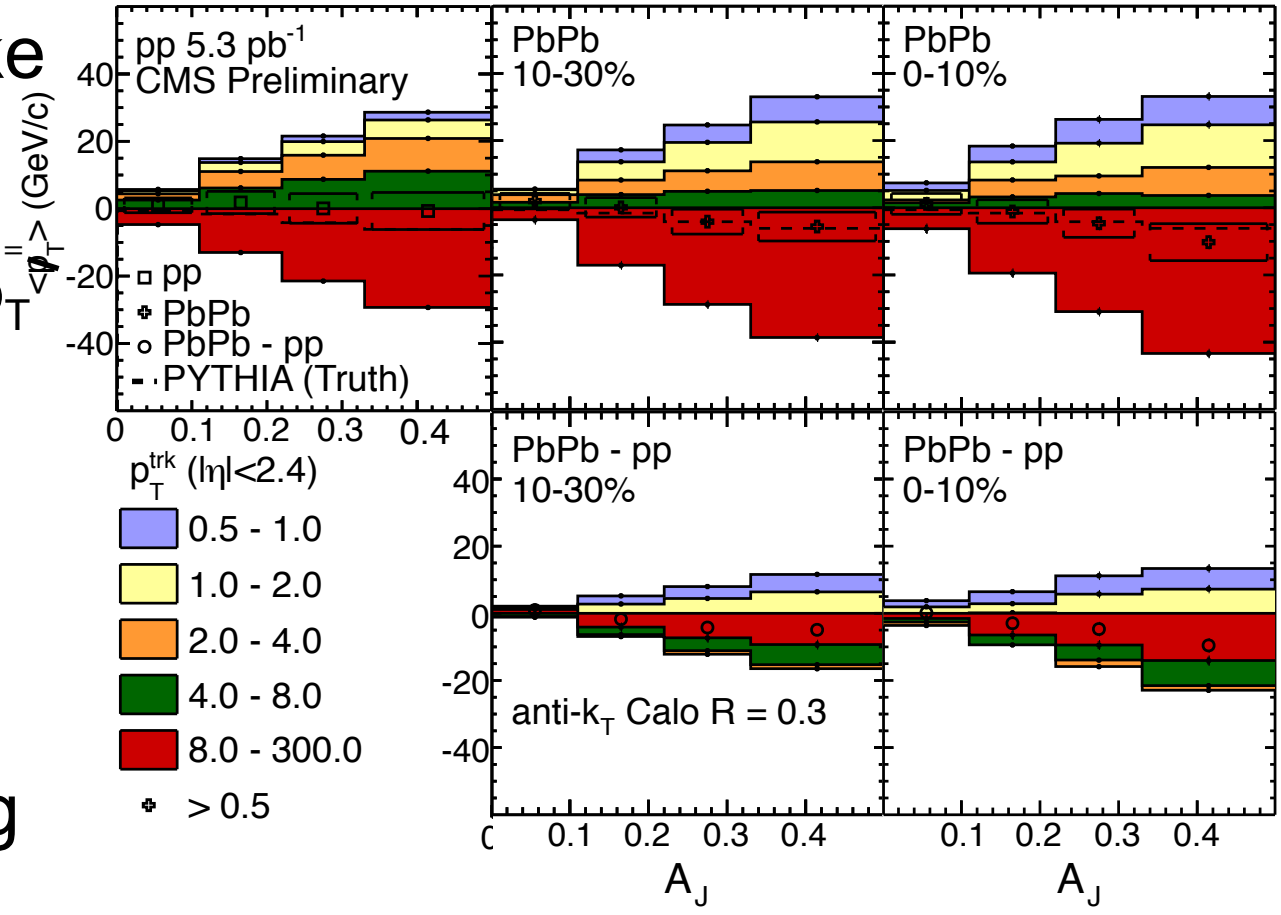
Fragmentation functions

- Uncertainty on JES/JER
- Tracking Uncertainty
- High-z measurements require good track and jet resolution
- Fake rate is reduced once “true” jets are selector
  - Calorimeter vetoes fake jets
  - Is it low enough?



Jet-track Correlations

- Requires low fake rate
  - Balance is achieved at low p_T
- JES/JER important
  - Di-jet imbalance
- Requires good efficiency and hermetic tracking coverage



Participation

- Code development for physics observables should occur in parallel to detector analysis
  - Detector groups need to inform us, but we can not wait weeks to start
  - We need volunteers!
  - Both fully simulated software frameworks and generators + detector parameterizations useful
- Meetings will be called as needed
  - Coordinating schedules for ~15-20 people is difficult but results can be discussed as produced
- Let us know how you would like to join in!

Proposed Timing

- 15 April - 30 April
  - develop code with private simulations
  - discuss best plots
- 30 April
  - Detector groups give us final geometry descriptions (we hope), generate “official” MC samples.
- 30 April - 18 May
  - Make “official” plots
  - make sure we understand then.
- 18-20 May
  - Collaboration Meeting, circulate “official” plots widely for input from Collaboration.
- 20-31 May
  - Coordinate with other topical groups & SPs to write document and message around plots

Conclusions

- Given the short timeline, best to work with a well defined goal and well defined observables
- “Official” Plots should be finalized by the collaboration meeting (May 18 – May 20)
- After May 31st we will pick a regular meeting time and expand the scope of the working group
- Next meeting time?